

No. 4. — *Contribution to the Knowledge of the Genus
Sminthurides Börner*

BY J. W. FOLSOM AND H. B. MILLS

INTRODUCTION

JUSTUS WATSON FOLSOM

(September 2, 1871 — September 24, 1936)

The bronze grasshopper which served as a knocker on the door of Dr. Samuel Scudder's laboratory in Cambridge, Massachusetts, was agitated by the hand of one of the youngsters of the neighborhood. The former student and assistant of Louis Agassiz arose, opened the door, and invited the young enthusiast with his box of butterflies across the threshold. Thus began the entomological career of Dr. Justus Watson Folsom, and thus are linked the names of three of America's most brilliant and colorful zoologists, Agassiz, Scudder and Folsom.

The entomological career which had its beginning that day in Cambridge ended in Vicksburg, Mississippi, on September 24, 1936, with Dr. Folsom's death. Between these two dates are packed endeavors, accomplishments and contributions which set a high standard among the entomologists of the world.

Very early in his training Dr. Folsom's interests began to revolve about that still poorly understood suborder of insects, the Apterygota, and this interest continued unabated until his death. His entomological textbook, especially the third edition, was a departure from the usual pattern of texts and far ahead of its time. It was the first American text to deal in any measure with the important fields of Insect Ecology and Physiology, and is a truly valuable inclusion in the entomologist's library.

Dr. Folsom was born in Cambridge, Massachusetts, September 2, 1871. Upon the death of his parents the responsibility for his training and education was shouldered by Mrs. Josephine Seymour, the mother of one of his friends. He continued to make his home with her and she with him as long as he lived. After preliminary schooling he entered Harvard College, obtaining an S.B. in 1895 and a Sc.D. in 1899 under the direction of Dr. E. L. Mark. Then followed a year as Professor of Natural Sciences at Antioch College. In 1900 he received an appointment to the Department of Entomology of the University of Illinois

remaining at that institution until 1923. In 1925 he entered the Bureau of Entomology of the United States Department of Agriculture, remaining in its service until the time of his death.

Dr. Folsom was an extremely careful worker, and if the definition of a genius is "one who has an infinite capacity for taking pains" he must be so classed. While working on the collembolan genus *Orchesella* in the summer of 1930 he spent several days mounting and examining many hundreds of specimens of *Orchesella hexfasciata* (Harvey), a very definite and clear-cut species and one with which he had long been familiar. "The microscopic examination of these insects is hard physical labor," he told the writer at one time, "But I am not satisfied until I have seen all that there is to see." He was constantly in search of better methods and new techniques for the examination and preservation of minute insects, and most unselfish with the information acquired. His care in giving credit to those who assisted him amounted to an obsession. He was extremely unselfish. When the writer first worked with him he pointed to a filing cabinet one day and said, "That file is full of new species which I have accumulated. Help yourself to it; work them up and describe them." That is a spirit not often demonstrated in the field of taxonomy.

The following paper is based on notes and sketches upon which Dr. Folsom was working at the time of his death.

HARLOW B. MILLS

The genus *Sminthurides* was proposed by Börner (1900, p. 616) to include the species *violaceus* Reuter, *aquaticus* Bourlet, *malmgreni* Tullberg, *penicillifer* Schäffer, *signatus* Krausbauer, *parvulus* Krausbauer, and *assimilis* Krausbauer, which previously had been included in the genus *Sminthurus* Latreille. The subgeneric description was as follows:

"Tibiotarsal organ present, antennal segment IV of the male developed into a clasping organ as in many copepods. In the species known up to now the under claw of the third pair is different from the other two. The upper claw is more slender and usually longer on the first two pairs than on the third. The dorsal inner edge of the mucro differs from the outer edge; the inner edge toothed. Mucronal bristle absent."

This description was corrected later (1901, p. 6), the clasping organ of the male not limited to the fourth antennal segment and the mucronal bristle noted as present.

The same author (1901, p. 91) raised the group to generic standing, and later (1906, p. 181) indicated *Smynthurus aquaticus* Bourlet as the type.

We follow Linnaniemi (1912, p. 247) in the use of the name *Sminthurides* Börner in place of *Prosmynthurus* Willem (1900, p. 55). Both of these generic names were proposed in 1900, with *S. aquaticus* Bourl. as the type (indicated later by Börner). Börner's name appeared in December, 1900, and Willem's is undated except for the year. It is very possible that *Prosmynthurus* has time priority, and it certainly has page priority over *Sminthurides*. The literature for the past thirty years has almost exclusively employed the latter name, following Börner's error (1901, p. 91) of postdating the appearance of *Prosmynthurus* to 1901. Until this matter can be settled definitely, it seems best to conform to usage and use the name *Sminthurides*.

Linnaniemi (1912, p. 247) observed but one pair of bothriotricha on the anogenital segment and suggested an emendation of the description to that effect. In all of the species which we have examined thus far two pairs were seen. The posterior pair is, however, subdorsal and usually much shorter and more bristle-like. On either side of the furcal segment the bases of these sensory hairs form an oblique, nearly straight line in all of the subgenera but *Denisiella*, where the bases are rather close together and form the points of a triangle.

There is a rather definite progression from *Sminthurides* s. str. through *Stenacidia* to *Denisiella*. The position of *Sphaeridia*, on the other hand, is somewhat anomalous. In the absence of a tibiotarsal organ and in the shape of the tenaculum it resembles *Denisiella*. The position of the bothriotricha of the furcal segment connect it with *Sminthurides*, while the simplification of the clasping antennae of the males isolate it from the other subgenera. Our present knowledge of the group leaves *Sphaeridia's* position debatable.

BIOLOGY

The species of this genus are predominantly water surface and humus inhabitants, although occasionally they have been taken from beneath bark and upon grass. Some species are beautifully adapted for life on water surfaces.

Aquatic forms furnish food for small fishes.

The biology of *Sminthurides* (*Sminthurides*) *aquaticus* Bourlet has been studied by several workers, Reuter (1883), Levander (1894),

Strebel (1927), and especially Falkenhan (1932). Although this species may not be typical of all of the others of the genus it is better known, and a summary of its biology is given here.

S. aquaticus feeds almost exclusively on soft dead and living plant material, unicellular algae, fungus spores, etc. The ventral tube is not an adhesive organ, probably not functioning as such in any Collembola, but functions exclusively for respiration.

One of the conspicuous phases of copulation is the grasping of the female antennae by the male antennae, the male usually being carried about for several days completely off the water surface. Transmission of sperms takes place at the beginning of the copulation process. Females are capable of copulation before they are fully grown. Parthenogenesis does not occur.

Oviposition follows copulation ordinarily by fourteen to eighteen days, the time depending on the temperature and the copulation age of the female, and occurs in moist soil surrounding water surfaces. A female may lay as many as sixty-six eggs. Temperature largely controls the length of the egg stage, which varies from three and one-half days to five months.

S. aquaticus can remain submerged for as long as four days. If it is not hindered from so doing, it usually succeeds in getting back to the water surface in from one to two days, where it shows no ill effects from the submersion.

All of the eggs from one female develop either into males or females, and the number of male- and female-producing mothers is about equal. Only six per cent of the females observed by Falkenhan (1932) produced broods of mixed sexes.

Males moult three times and females between five and seven times, becoming sexually mature after the third moult.

Males usually live for four or five weeks and the females from two to three and one-half months. The sex ratio, which is originally about 1:1 changes later in favor of the females due to their longer life. Males and females are found together throughout their active period, and from seven to ten generations occur each season. The winter is passed normally in the egg stage, but in southern latitudes, or in exceptionally warm winters in northern regions, a few adult females may hibernate.

The chief enemy of *S. aquaticus* in Europe is the mite *Episcius sphagni* (Halbert), which is frequent about the edges and on the surfaces of small pools which the Collembolans inhabit.

Genus SMINTHURIDES Börner 1900

Vesicles of ventral tube short, smooth, without lateral tubercles but sometimes with apical papillae. Segmentation of the body usually evident through intersegmental sutures or light lines. Corpus of tenaculum with lateral clavate processes at the bases of the rami. Integument granulate. Anal segment ankylosed with the genital segment, which is broadly united to the furcal segment. Body with five pairs of bothriotricha, three pairs on the furcal segment and two on the anogenital division. Anal appendages of female wanting. Second and third segments of the antennae of the male modified into a clasping organ, the fourth segment always simple. Antennae of female not modified, the fourth segment simple, ringed or definitely subsegmented. Tibiotarsal organ of posterior legs present or absent; when present, composed of two tooth-like eversions and a heavy spine which may be lamellate, notched, or definitely bifid. Except for the subgenus *Denisiella*, the first two pairs of ungues are longer, more slender, and usually definitely unidentate on the inner margin, differing from the posterior ungues which are shorter, broader, and usually weakly toothed or un-toothed; first two pairs of unguiculi usually short and narrow, the third pair much broader and definitely lamellate; subapical unguicular filaments present, tenent hairs absent. Eyes normally eight on either side. Length seldom over 1 mm., usually much less.

Key to the Subgenera of Sminthurides Börner

1. Tibiotarsal organ of 3rd pair of legs (figure 5) present, composed of 2 sacs and an enlarged spine 2
Such tibiotarsal organ absent 3
2. Mucronal edges with weak, or without true lamellae, dorsal inner edge toothed. Mucro slender, definitely narrowed in the apical third.
Ant. IV simple (figure 89) *Stenacidia* Börner. P. 262
Mucronal edges more or less broadly lamellate, inner lamella toothed and ribbed (figure 12). Ant. IV simple, ringed, or subsegmented.
Sminthurides Börner. P. 235
3. Mucronal bristle absent (figure 106) *Sphaeridia* Linnaniemi. P. 268
Mucronal bristle present (figure 100) *Denisiella* n. subg. P. 264

Subgenus SMINTHURIDES Börner s. str.

1843, *Sminthurus* Bourlet p. 58 (*ad. partim*). 1900, *Smithurides* Börner p. 616 (*ut subgenus*). 1900, *Prosminthurus* Willem p. 55. 1901, *Sminthurides* Börner p. 91.

Tibiotarsal organ present. Mucrones with 3 well developed lamellae, the inner always toothed; mucronal bristle present. Antennae usually longer than the head, the 4th segment simple, ringed, or definitely subsegmented. Corpus of tenaculum usually subconical, exceeding the rami of the tenaculum, and with anterior and apical bristles. Vesicles of ventral tube simple or with as many as 6 apical tubercles. Anogenital segment broadly united with the rest of the body, the 5th and 6th segments sometimes separated dorsally by a constriction. Type: *Sminthurides aquaticus* (Bourlet).

Key to the species of the subgenus Sminthurides Börner s. str.

1. Mucro apically bulbous or apparently so, with coarse teeth on inner lamella (figure 83) 2
 Mucro not apically bulbous. Inner lamella with finer teeth (figure 32) . . 4
2. Ventral mucronal lamella ending in a sharp tooth before the apex (figure 83) *lepus* Mills 1934
 Ventral mucronal lamella entire (figure 78) 3
3. Ungues stout, inner tooth beyond the middle. Mucro not hooked apically.
 Basal segment of fourth antennal segment related to apical about as 2:1. (figure 78) *occultus* Mills 1934
 Ungues slender, the inner tooth situated before the middle. Mucro hooked apically. Basal segment related to the apical about as 2.2-2.5:1 (figure 76) *macnamarai* n. sp.
4. Mucro trough-shaped, both sides alike (figure 88) *plicatus* Schött 1891
 Mucro not as above, the sides dissimilar 5
5. Filament of hind unguiculus of female branched (figure 45) 6
 Filament of hind unguiculus of female simple (figure 57) 9
6. Filament 2- or 3-branched. Fourth antennal segment of female ringed (figure 45) *bifidus* Mills 1934
 Filament of hind unguiculus 4- to 6-branched 7
7. Seta of organ of third tibiotarsus simple. Hind unguicular filament 4-branched (figure 40) *appendiculatus* Imms 1912
 Seta of organ of third tibiotarsus wide, bifid. Unguicular filament 5- or 6-branched 8
8. Fourth antennal segment not subsegmented. Apex of bristle of tibiotarsus III organ not attaining the base of the unguiculus. Unguicular filament of the first 2 pairs of legs simple, sharp (figure 49)
 *penicillifer* Schäffer 1896
 Fourth antennal segment subsegmented with 7 (?) irregular divisions.
 Apex of bristle of tibiotarsus III organ passing the base of the unguiculus. Unguicular filament of first 2 pairs of legs flat, lanceolate in its distal portion *pauliani* Denis 1936

9. Antennae shorter than the head (figure 1) 10
 Antennae equal to or longer than the head 11
10. Mucro with 10–12 inner teeth. Vesicles of ventral tube with several terminal papillae *cruciatu*s Axelson 1905
 Mucro with about 9 inner teeth, apically pointed. Vesicles? Clothing not remarkably short *hospes* Börner 1907
11. Fore unguiculi very long, lanceolate, appressed, apex exceeding apex of unguis (figure 39) *spagazzinii* Börner 1907
 Fore unguiculi not as above 12
12. Fourth antennal segment of female simple 13
 Fourth antennal segment of female distinctly subsegmented 17
13. Organ of 3rd tibiotarsus of male with a bifid seta, 2 elongate swellings, and a lateral blunt club (figure 3, 4) *stagnalis* Womersley 1932
 Organ of 3rd tibiotarsus usually with a simple seta. Accessory club absent in male 14
14. Mucro bearing a subapical fingerlike projection. Fourth antennal segment of female with a basal subglobose portion, separated from the apical part by a constriction, apical part gradually and rather evenly narrowing to apex (figure 6) *globocerus* n. sp
 Fourth antennal segment of female without a conspicuous basal globose region or finger-like projection of mucro 15
15. Mucro at least half as broad as long (figure 12). Seta of 3rd tibiotarsus organ usually extending far beyond the apex of the tibia, not lamellate. Dorsal segmentation of body evident *aqualicus* Bourlet 1843
 Mucro one-third as broad as long (figure 30). Seta of 3rd tibiotarsal organ not greatly exceeding the apex of tibia, lamellate. Dorsal segmentation of body not evident 16
16. Abdominal segments 5 and 6 demarcated dorsally. Mucro apically rounded (figures 26, 27). Ventral tube vesicles with 6 papillae. Seta of tibiotarsal organ broad, bifid *ludovicianus* n. sp.
 Abdominal segments 5 and 6 confluent. Mucrones apically pointed (figure 30). Vesicles of ventral tube simple. Seta of tibiotarsal organ tapering, normally simple lamellate *malngrenii* Tullberg 1876
17. Fourth antennal segment joints 7 and 8 weak ringlike subsegments, with narrow ringlike divisions between them (figure 41)
melanotus Börner 1907
 Fourth antennal segments definitely subsegmented usually with 4 or 5 subsegments 18
18. Subsegments of 4th antennal segment of female 7 or 8, none greatly longer than the rest (figure 70) *annulicornis* Axelson 1905
 Antennae with 4 or 5 subsegments in the 4th segment (figure 73) 19
19. Basal subsegment subequal to the apical (figure 52) 20
 Basal subsegment about twice the length of the apical (figure 79) 21

20. Fourth antennal segment of female with 4 subsegments. Mucro strongly narrowed apically and rounded. *schöttli* Axelson 1903
 Fourth antennal segment with 5 subsegments. Mucro not strongly narrowed apically, truncate. *parvulus* Krausbauer 1898
21. Fourth antennal segment of female with 4 subsegments. 22
 Fourth antennal segment with 5 subsegments. *inequalis* Börner 1903
22. Mucro strongly narrowed toward the apex. Length of females 0.5 mm. Body light, with dark blue stripe on the sides and a dorsal, broken colored area (figure 58). *assimilis* Krausbauer 1898
 Mucro slightly narrowed distally. Length of females 0.35–0.45 mm. Color lighter or darker violet, pigment diffuse (figure 64).
krausbaueri n. nom.

SMINTHURIDES CRUCIATUS Axelson (Linnaniemi)

Plate I, fig. 1

1905, *Sminthurides cruciatus* Axelson, p. 792.

Color of body largely dark violet. Body with a median-dorsal dark stripe with transverse branches. Sides of abdomen mostly pale, or ventrolaterally dark. On the sides, especially posteriorly, are several roundish dark spots. Anogenital segment almost entirely violet. Antennae, legs, and furcula pale violet. Head pale, marked with violet. Oral region dark. Eyes 8 on either side. Antennae clearly shorter than the head (figure 1), as 6:7, the segments about as 7:8:13:23. Last antennal segment simple, unringed. First 2 pairs of unguis slender with an inner tooth at about the middle and small lateral teeth. Unguiculi of these feet short, slender, with small lamellae, scarcely half the length of the unguis; filaments exceeding the apex of the unguis. Third pair of unguis shorter than the others, with small inner tooth and lateral teeth. Unguiculi of these feet $\frac{2}{3}$ the unguis, with broad lamellae and filaments which exceed the unguis. Organ of 3rd tibiotarsus composed of 2 elongate swellings and a short, simple, basally broad seta which extends a little beyond the tibiotarsus. Ventral tube with several papillae at the end of the vesicles. Tenaculum with the corpus conical and bearing 2 strong anterior setae; rami 3-toothed, each with a basal clavate appendage. Dens 2.3 times the mucro. Mucrones bent apically, with relatively narrow lamellae; about $\frac{1}{3}$ as broad as long; inner lamella with 10–12 teeth, narrowing toward the apex and ending in a sharp tooth-like projection, outer lamella ribbed but without teeth, ventral lamella narrow but evident. Mucronal seta present. Clothing

exceptionally sparse and short. Integument finely granulate. Length up to 0.66 mm.

Sweden, Finland.

This species occurs on water surfaces with such species as *S. malmgreni elegantus* Reut. and *S. aquaticus* Bourl., sometimes among water plants.

SMINTHURIDES HOSPES Börner

Plate I, fig. 2

1907, *Sminthurides hospes* Börner, p. 172.

Weakly pigmented with violet, darker on the posterior dorsum. Dentescapulae and mucrones pale, claws not plainly pigmented. Antennae violet, becoming darker distally. Eyes 8 on either side. Head only a little longer than the antennae, the segments of which are related about as $1:1\frac{2}{5}:2\frac{1}{5}:4$, or $1:1\frac{1}{2}:2\frac{3}{4}:4\frac{3}{4}$. Last antennal segment simple, not subsegmented. Body very highly arched. Ungues apparently without inner or lateral teeth, the first 2 pairs somewhat longer and more slender than the last (figure 2). Unguiculi on the first 2 pairs of feet with a concave inner lamella and subapical filament which attains the apex of the unguis (exceeds it in Börner's figure 40). Ungues and unguiculi of 3rd feet almost as in *aquaticus* but narrower, the filament exceeding the apex of the unguis. Tibiotarsal organ with the bristle bearing a short ventral accessory branch, scarcely reaching the base of the unguiculus. Anterior lobe of the tenaculum extending as far as the rami, apparently with only 1 seta. Dens to the mucro as 3:1, furcula short. Dens dorsally and toward the apex in some degree clearly granulate. Mucrones more slender than in *spagazzinii* and *melanotus*, recalling *signatus* Krausbauer. About 9 teeth on the inner lamella, pointed. Clothing relatively thick and long. Length up to 0.5 mm.

La Plata, Argentina.

Taken from water surface among water plants.

SMINTHURIDES STAGNALIS Womersley

Plate I, figs. 3-4

1932, *Sminthurides stagnalis* Womersley, p. 16.

Light brownish violet, with a median dark stripe. Eyes 6 (?) on either side. Antennae a little longer than the head, as 6:5 in the male. Male with the usual well developed clasping organ. Ungues similar on

all feet, with no inner teeth. Unguiculi with moderately broad inner lamellae, and subapical filaments. Tibiotarsal organ with the seta short, broad, bifid. On the inner side of each posterior tibia of the male is a short strong spine above which is a longer thumb-like projection (figure 3). Mucro 0.4 the dentes, the inner lamella with strongly ribbed teeth (12 in Womersley's figure 3c), of the *aquaticus* type, with a simple pointed apex. In the male on the anogenital segment are 2 long protuberances, each with 2 or 3 subapical spines (figure 4); just behind these is a short peglike projection. Clothing sparse, of long fine hairs. Length male 0.57 mm., female 0.69 mm.

Collected on surface of stagnant pool, Denmark, West Australia.

SMINTHURIDES GLOBOCERUS spec. nov.

Plate I, figs. 5-7

Female. Ground color in light specimens pale yellow; pigment dark purple. Dorsum posteriorly purple, anteriorly pale yellow and usually crossed by 3 or 4 irregular, subparallel, purple bands which are broken on the midline; laterally purple. Head yellow dorsally, purple about the oral region. First antennal segment pale yellow with an apical mark; 2nd yellow with an apical ring; 3rd violet, pale basally; 4th entirely violet. Legs tinged with pale violet. Furcula unpigmented. Dark forms have the head and body blackish purple, sometimes almost slate black, with irregular lighter spots vaguely showing through. The venter is somewhat lighter especially at the insertion of the furcula, and the appendages darkly, diffusely purple. Eyes probably 8 on either side. Antennae definitely longer than the head, the segments about as 10:12:28:53 or 12:13:29:59. Fourth segment simple, a sub-basal constriction cuts off a globose basal region which does not, however, represent a subsegment (figure 6). Beyond this constriction the segment gradually tapers to a rather acute apex. First 2 pairs of ungues rather slender, with a weak inner tooth beyond the middle and 2 lateral teeth on each side. Unguiculi narrow, rather wider basally, with subapical filaments exceeding the ungues. Ungues of the hind legs (figure 8) without the inner tooth, broader. Unguiculi broadly lanceolate with definite, well developed lamellae and filaments which exceed the ungues. Seta of tibiotarsal organ heavy, lamellate, bifid, reaching slightly beyond the apex of the tibiotarsus; the 2 basal sacs large, elongate, overhanging their insertions (figure 5). Dentes 2.2 times the mucrones, with a small inner thumblike projection. Mucro

with a prominent blunt projection dorsally at the apex. Inner dorsal lamella with 10-15 teeth, outer lamella usually with a small sub-basal tooth which is difficult to see, ventral lamella entire; mucro 3 or more times as long as broad; mucronal bristle present (figure 7). Dentes with numerous curved hairs dorsally and 3 longer suberect dorsal setae, the clothing recalling somewhat the condition in *Denisiella*. Ventral bristle formula 1,1,1,1,2,2,2,2, the 2 single basal hairs minute. Body anteriorly with short moderately heavy hairs, posteriorly with longer, more numerous, backward-curving setae. Bothriotricha of the body 3 on either side, nearly in a straight line. Anogenital segment with 2 on either side. Tenaculum with the corpus subconical, bearing 1 apical and 2 anterior bristles. Rami 3-toothed, with basal clavate appendages. Fifth and 6th abdominal segments clearly separated dorsally. Length 0.43.

Male. Coloration similar to that of the female, anterior dorsum sometimes without the dark crossbands, head mostly purple dorsally and orally. Clasp organ highly developed. Metanotum with a pair of subdorsal vesicles. Inner dorsal lamella of mucro with 10 or 11 teeth. Length 0.41 mm.

North Carolina. Asheville, February 9, 1935. A. P. Jacot. Several specimens of both sexes from *Andropogon* sod.

SMINTHURIDES AQUATICUS (Bourlet)

Plate I, figs. 9-13; Plate II, figs. 14-19

1843, *Smynthurus aquaticus* Bourlet p. 58. 1883, *Sminthurus apicalis* Reuter p. 20. 1896, *Smynthurus amicus* Folsom p. 446. 1900, *Prosmynthurus aquaticus* Willem p. 6. 1900, *Sminthurus (Sminthurides) aquaticus* Börner p. 616. 1901, *Sminthurides aquaticus* Börner p. 96.

This widespread and variable species has been separated into the following forms:

var. AQUATICUS f.p.

Yellow or brownish yellow; first 2 antennal segments pale brown; 3rd and 4th purple; legs pale brownish.

This principal form of the species occurs in most parts of Europe but has not been recorded from North America.

var. VIRIDULUS (Reuter)

1891, *Sminthurus apicalis* var. *viridulus* Reuter p. 231. 1893, *Sminthurus aquaticus* var. *viridulus* Schött p. 37. *Sminthurides aquaticus* var. *viridula* Börner p. 98.

Greenish; often with a narrow dark median dorsal line. Antennae and legs tinged with purple.

This European variety has not been recorded from North America. Linnaniemi (1912, p. 260) found it abundant in sphagnum moss.

var. LEVANDERI (Reuter)

1891, *Sminthurus apicalis* var. *levanderi* Reuter p. 232. 1893, *Sminthurus aquaticus* var. *levanderi* Schött p. 37. 1901, *Sminthurides aquaticus* var. *levanderi* Börner p. 98.

Female. General color from rose pink to deep rose purple or violet; sides of the abdomen often olivaceous, with pale spots as in fig. 19. Sternum pale. Vertex yellow or whitish, with a wide median purple mark. Oral region and apices of legs blackish purple. Antennae mostly purple to violet; 1st and 2nd segments pale yellow or whitish. Legs pale purple with femora and tibiotarsi often violet. Manubrium and dentes dilute purple, dentes darker proximally and distally. Claws and mucrones pigmented. Antero-dorsum typically with strong segmented folds separated by pale intersegmental lines; the folds may, however, be weak or absent. Head with a dorsal ridge behind the vertex (figure 19). Fifth and 6th abdominal segments are not separated. Eyes 8 on either side, 2 in each group being smaller than the others (figure 9). Antennae slightly longer than the head, as 1.2:1; the 4th segment simple; the segments related as 10:14:25:51 (specimen from England) or 6:8:21:32 (specimen from Finland). First and 2nd unguis typically very slender but often comparatively stout, with an inner tooth (sometimes obscure) beyond the middle and 2 pairs of lateral teeth (figures 14, 15, 17, 18). First and 2nd unguiculi also slender with a subapical filament of variable length. Third unguis shorter than the 1st and 2nd, the inner tooth lacking (figures 13, 16). Third unguiculi subovate with a feebly subapical filament exceeding the unguis. Tibiotarsal organ with a strong bristle which extends far beyond the apex of the tibiotarsus (figure 11). Vesicles of ventral tube simple. Rami of tenaculum tridentate, with basal clavate appendages. Corpus with 2 long anterior setae and 2 smaller ones on the apex (figure 10). Dentes from 2.3 to 3 times as long as the mucrones. Mucrones convergent, spoonlike in general form, elliptical from above,

more than half as long as broad (as 32:51); inner dorsal lamella with as many as 17 teeth; mucronal seta present (figure 12). Clothing of moderate length. Posterior dorsum with stiff setae. Often the setae of head, body, antennae, and legs situated each on a black spot. There are 5 pairs of bothriotricha as usual. The first (most anterior) is on the 2nd abdominal segment, the 2nd apparently on the 3rd, the 3rd probably on the 4th; the 4th and 5th are apparently on the 5th abdominal segment. Integument minutely granulate. Length 1.0 mm.

Male. In coloration like the female. Antennae modified for clasping. Metanotum with a pair of subdorsal bladderlike eversible hyaline vesicles. Maximum length 0.5 mm.

The foreign material of *aquaticus* which has been examined consists of numerous specimens from Germany (C. Schäffer), Poland (J. Stach), Finland (W. Linnaniemi), England and Iceland (W. M. Davies). In all of this material the 1st 2 pairs of unguis are very slender, although varying somewhat in this respect. In the United States this typical form with slender unguis is present and widespread, though we record it as yet only from Massachusetts, North Carolina, Louisiana, and Utah. The prevailing form in North America is one with comparatively stout unguis. Both forms may occur in the same locality. The unguicular filament varies greatly in relative length in European material. It may extend not quite so far as the inner tooth of the unguis or it may exceed the unguis, but is commonly short on the 1st pair. In North American material with the typical slender unguis the filament is short on the anterior feet; it exceeds the unguis in the specimens with stouter unguis. The 2 vesicles of the tibiotarsal organ vary in size and form; sometimes they are slender.

Both European and American examples have on all of the unguis 2 pairs of lateral teeth which have not been mentioned in previous descriptions. This species is common on the surface of the water of ponds and streams and on various aquatic plants. It is found also on adjacent damp humus, in which the eggs are laid. Occasionally it is encountered in moss. It is not limited to fresh water but occurs also on pools of salt water.

Some of the individuals examined had desmids in the alimentary tract. *S. aquaticus* occurred with *S. malmgreni* in the stomachs of fingerling trout, but in smaller numbers than *malmgreni*. Two of the fishes had each eaten 20 springtails, and 7 had eaten in all about 70.

S. aquaticus is a common species throughout Europe and is on record from Algeria. The records indicate that it probably occurs in most parts of North America.

Maine, Massachusetts, New York, New Jersey, North Carolina, Ohio, Illinois, Iowa, Louisiana, Texas, Utah, Washington, Ontario, British Columbia, Northwest Territories (Bernard Harbor).

SMINTHURIDES LUDOVICIANUS spec. nov.

Plate III, figs. 20-27

Head and body mostly dark purple. Abdomen laterally purple and olivaceous with pale yellow spots. Dorsum pale yellow with 3 or 4 pairs of purple bars or spots separated along the median dorsal line. Sternum pale. Head purple, pale yellow between the eyes; oral region dark purple. Antennae violet, the first 2 segments paler. Legs and furcula unpigmented or the legs pale violet. Tibiotarsi darker apically. Eyes 8 on either side of the head. Antennae slightly longer than the head, as 1.1:1, with the segments about as 15:18:41:70; 4th segment not subsegmented. Ungues almost straight (figures 20-22), with a pair of lateral teeth, and an inner tooth which is evident on the anterior 2 pairs and obscure or absent on the 3rd. Unguiculi broadest on hind feet, with subapical filament which greatly exceeds the unguis on the fore feet and about equals it on the posterior pair. Setae of the tibiotarsal organ stout, lamellate, strongly bifid, extending about to the apex of the tibiotarsus (figure 23). Vesicles of ventral tube with 6 large terminal papillae (figure 25). Corpus of tenaculum with a pair of anterior and a pair of apical setae (figure 24). Mucrones $\frac{2}{5}$ as long as dentes, apically rounded in dorsal aspect; inner dorsal lamella with about 13 teeth (figures 26, 27). Mucronal seta present. Fifth abdominal segment is delimited from the 6th dorsally by a deep groove. Dorsum of body with stiff setae, sparse and short anteriorly and numerous and long posteriorly. Abdomen with 3 pairs of bothriotricha, 5th segment with 1 pair. Integument minutely granulate. Length of female 0.62 mm. Males were not seen.

S. ludovicianus resembles *S. malmgreni*, from which, however, it differs aside from coloration in the following respects:

	<i>ludovicianus</i>	<i>malmgreni</i>
5th and 6th abdominal segments	Demarcated	Confluent
Mucro	Apically rounded	Apically pointed
Vesicles of ventral tube	6-lobed	Simple
Seta of tibiotarsal organ	Short, stout, bifid	Long, tapering, normally simple.

Louisiana. Tallulah, March 2, 9, in humus in swamp, 2 females.

SMINTHURIDES MALMGRENI (Tullberg)

Plate III, figs. 28-31; Plate IV, figs. 32-38

1876, *Sminthurus malmgrenii* Tullberg p. 30. 1883, *Sminthurus elegantulus* Reuter p. 204. 1896, *Smynthurus socialis* Folsom p. 446. 1900, *Sminthurus (Sminthurides) elegantulus* Börner p. 616. 1901, *Sminthurides malmgreni* *elegantulus* Börner p. 94. 1905, *Sminthurus (Sminthurides) malmgreni* Becker p. 9. 1905, *Sminthurides malmgreni* Axelson p. 40.

The typical form is dark purple, in alcohol often bluish black. Head paler, with whitish spots, and a large white spot between the bases of the antennae. Oral region black. Sternum, legs, and furcula pale purple. Antennae dark purple.

This form has been recorded from Finland and from some of the Arctic islands.

S. malmgreni varies greatly in coloration:

var. *nigrescens* Börner, 1901, p. 96.

Blackish dorsally, laterally with small pale spots which may coalesce into large spots. Appendages purple. Common in Finland and Germany.

var. *quadrilineatus* Ågren, 1903, p. 161.

With 4 stripes, 2 paramedian and 2 lateral. Sweden.

var. *maculatus* Ågren, 1903, p. 161.

Median dorsal stripe reduced to a small spot. Sweden.

var. *immaculatus* Axelson, 1905, p. 792.

Median stripe absent. Finland.

All of these color variations vary into each other. The last 3 occur in North American as well as Europe. The commonest variety, in both Europe and North America, is *elegantulus*.

var. ELEGANTULUS Reuter, 1883, p. 20

Female. Fresh specimens are lemon yellow with 3 wide, broken-margined purple stripes; a median dorsal stripe or mark and 2 ventrolateral stripes which continue across the head (figure 38); all three connected posteriorly by a transverse band. The median dorsal mark may assume a great variety of forms; it may even be broken into a series of transverse bars. Sternum white or pale yellow. Head mostly yellow, oral region purple to blackish. First antennal segment pale, often yellow; 2nd segment yellow or violet; 3rd and 4th segments violet. Legs pale yellow or whitish, dark purple distally; or pale purple or violet throughout. Furcula mostly unpigmented but often purple

basally and apically; sometimes pale purple or violet throughout. Head with a prominent transverse rounded ridge behind the vertex. Eyes 8 on either side, 2 on either side smaller than the others. Antennae longer than the head (as 1.3:1) with segments about as 11:14:29:48; 4th segment simple. Ungues of the 2 anterior pairs of legs slender with an inner tooth at or beyond the middle and a pair of lateral teeth (figures 33, 36). Unguiculi of these feet slender, lanceolate, with the subapical filament exceeding the unguis. Ungues of the posterior feet $\frac{2}{3}$ as long as the anterior unguis, without an inner tooth but with a pair of lateral ones (figure 35). The posterior margin of each unguis is serrate (figure 34). Posterior unguiculi subovate, with a relatively short feebly subapical filament. Seta of tibiotarsal organ lamellate basally, exceeding the tibiotarsus and often attaining the base of the unguiculus (figure 28). Vesicles of ventral tube simple. Lobe of tenaculum with 2 long anterior setae and 1 or 2 short ones on the apex (figure 31). Dentes 2.5 times as long as the mucrones. Mucrones convergent, elliptical, $\frac{1}{3}$ as broad as long; the inner dorsal lamella ends in a prominent tooth, usually with 9-12 teeth, occasionally 13-14 (figures 30, 32). Mucronal bristle present. Dorsum of body with short curving setae. Five pairs of bothriotricha are present, 3 on the abdomen proper and 2 on the 5th segment. Integument finely granulate. Length 0.65 mm.

Male. Structurally like the female, and similar also in color. Antennae modified for clasping. Dorsal segmentation of the body weakly indicated by low folds and pale intersegmental lines. Metanotum with a pair of large subdorsal elliptical organs emitting a globose hyaline vesicle. Fifth abdominal segment evident dorsally as a ridge. Five pairs of bothriotricha present. Length 0.35 mm.

The European material examined consists of specimens from Germany (C. Schäffer), Poland (J. Stach), Finland (W. Linnaniemi), England (M. Dávies), and Scotland (W. Evans). In North American material, also in specimens from Finland, Poland, and England, the inner tooth of the anterior and middle unguis is seldom absent, and that of the posterior unguis is rarely present. In German specimens, on the contrary, the inner tooth is absent on the anterior 2 pairs and present on the hind unguis. Rarely the posterior margin of the hind unguis is entire instead of serrate. The serrations are present in specimens from Finland and Poland, but they are not mentioned in European descriptions.

Elegantulus is by far the commonest variety of *malmgreni* in temperate Europe and North America. It occurs on the surface of pools

and streams, on aquatic vegetation, on damp soil adjacent to bodies of water, and in damp moss. It feeds on desmids and other minute plant forms. This variety has some importance as food for young fishes. Mr. H. J. Paek, at Ithaca, N. Y., May 17, 25 and June 10, 1924, found it in the stomachs of fingerling trout which were 25-30 mm. long. One of these small fishes had eaten about 200 individuals. Twelve fishes contained a total of more than 400 of the springtails. Such a large number of individuals, scattered on the surface of the water, could hardly have been consumed accidentally.

The following records refer to the variety *elegantulus* in North America:

Massachusetts, New York, Illinois, Louisiana, Wyoming, Ontario.

SMINTHURIDES MALMGRENI var. PALUSTRIS var. nov.

This is a color variety, which structurally agrees essentially with *elegantulus*.

Female. Body laterally and often posteriorly diffuse purple, without lateral stripes; or general color maroon, blue, brownish, or ferruginous (figure 37). Ground color pale yellow. Dorsum commonly yellow anteriorly; posteriorly with a median purple mark or a pair of paramedian marks; these marks varying greatly in form. The dorsum may be entirely yellow or purple. Sides of the abdomen with small pale yellow or white spots. Sternum white or pale yellow. Head pale yellow dorsally, blackish orally, with a median maroon stripe between the eyes and a white mark bordering the inner edge of each eye. First antennal segment pale yellow, 2nd pale yellow to purple, 3rd and 4th purple. Legs whitish, purple, or brownish, with tibiotarsi commonly pale purple and darker apically. Manubrium and dentes unpigmented or dentes dull purple proximally and distally. Setae of tibiotarsal organ exceeding the segment, and sometimes extending as far as the base of the unguiculus; lamellate and often, but not always, bifid (figure 29). Clothing of moderately long setae, each on a black spot. Length 0.77 mm.

Male. In coloration similar to the female. Head and body rose purple to dull purple. Dorsum pale yellow, sides dull purple. Length 0.4 mm.

Dr. Jan. Stach, to whom examples of *palustris* were sent, reported that this variety agrees structurally with the European *malmgreni*, even to the setae of the tibiotarsal organ and the serrate posterior margin of the hind unguis.

This color variety often occurs in company with *elegantulus*, and is wide spread in North America, as the following data show:

New York: Ithaca, R. B. Hughes.

Illinois: Karnak, February 24, H. H. Ross and C. O. Mohr.

Iowa: Ruthven, October 2, H. M. Harris and B. V. Travis.

Louisiana: Tallulah, January 3, 19, 22, February 19, March 9, 15, 20, 21, April 13, 15, 18, October 12, November 11, J. W. F.

Texas: College Station, H. B. M.

Utah: Logan Meadows, Logan, May 5, G. F. Knowlton and C. F. Smith; Benson, May 3, G. F. K. and C. F. S.; N. W. Amiaga, May 4, G. F. K. and J. A. Rowe; E. Newton, May 4, G. F. K. and C. F. S.

Montana: Bozeman, August 10, H. B. M.

Washington: Yakima, April 19, A. R. Rolfs; Lake Tipsoe, October 11, A. R. R.

Ontario: Arnprior, March 2, May, June, C. Macnamara.

SMINTHURIDES SPEGAZZINII Börner

Plate V, fig. 39

1907, *Sminthurides spegazzinii* Börner pp. 170-171.

Dull straw yellow. Violet pigment on sides and posterior region of abdomen. Anogenital segment pale dorsally. Apices of tibiotarsi and antennae violet, the last 2 antennal segments especially so. Eyespots especially large and black. Frontal ocellus relatively large. Oral region dark. Eyes 8 on either side. Antennae to the head as $8\frac{1}{3}:8$ or $7\frac{2}{9}:7\frac{1}{5}$, the segments as $1:1\frac{3}{4}:2:3\frac{3}{8}$ or $1:1\frac{5}{9}:1\frac{2}{3}:3$. Last antennal segment simple. First 2 pairs of unguis elongate, with 1 inner tooth beyond the middle and no lateral teeth (figure 39). First 2 pairs of unguiculi awl-shaped, a little broader before the apex giving it a lance-like appearance, exceeding the unguis, with a reduced lamella close to the base. Third pair of unguis shorter and broader basally, with no inner teeth but basally and in the distal third with lateral denticles. Unguiculi of 3rd feet with concave inner lamella, filament subapical and far exceeding the unguis. Seta of tibiotarsal organ long, broadened basally, on the ventral side with 1 or 2 fine branches, reaching the base of the unguiculus; papillae elongate. Corpus of tenaculum elongate with 1 pair of long setae at level with base of rami, and 1 short apical seta. Dens to mucro as $2\frac{2}{5}:2\frac{1}{3}:1$. Furcula like *aquaticus*. Dentes and manubrium only dorsally uni-

formly and finely granulate. Mucro with wide lamellae, the inner one with 14 ribbed teeth. Clothing of head and body short, not abundant. Length up to 1 mm.

On water plants, La Plata, Argentina.

SMINTHURIDES MELANOTUS Börner

Pl. V, fig. 41

1907, *Sminthurides melanotus* Börner p. 171.

Very close to *spgazzinii*. Lamellae of first 2 pairs of unguiculi relatively longer, allowing the subapical filament to appear. On the first 2 pairs of ungues the inner tooth is a little farther distal (almost at the beginning of the last third), and the unguis beyond it is clearly constricted. Similarly, lamellae of 3rd unguiculi are relatively longer and broader basally. Antennae longer than the head, as $9\frac{3}{8}$ - $8\frac{1}{2}$ or $11\frac{3}{4}$ -11; the segments as $1:1\frac{1}{8}:2\frac{5}{8}:4\frac{3}{8}$ or $1:1\frac{1}{2}:3\frac{1}{4}:6$; the 3rd segment considerably longer than the 1st. Fourth antennal segment (as in *penicillifer*) ringed, with 3 to 6 discernible intermediate rings (figure 41). Dens to mucro as 3.25:1 or 2.9:1. Violet pigment finely and uniformly distributed over the entire body. Dens pale. Mucro and claws pigmented. Antennae, especially 3rd and 4th segments, dark violet. Dorsum with a narrow to broad dark violet median stripe, not sharply bounded laterally, ending above the hind coxae and shortly before the anogenital segment. Male with the usual clasping antennae and a pair of subdorsal sac-like appendages.

Taken with *spgazzinii*, La Plata, Argentina.

SMINTHURIDES APPENDICULATUS Imms

Pl. V, fig. 40

1912, *Sminthurides appendiculatus* Imms p. 117.

Ground color leaden. Legs and furcula paler. Antennae dark leaden, suffused with purplish. Body indigo blue, with small pale yellow markings. A pale yellow dorsal area on the head, bearing a small bluish spot between the eyes. Antennal segments as 8:11:22:32, the 4th segment simple. The first 2 pairs of claws similar, ungues very long and slender, slightly curved apically, untoothed. Unguiculi $\frac{1}{5}$ longer than the ungues, setiform and whiplike, usually with a minute "ventral tooth" near the base (possibly the junction between the unguiculus and filament was not noted). Posterior ungues shorter and smaller than the

others, untoothed, unguiculi with a whiplike subapical filament plus 3 slender appendages at the base of the filament (figure 40). Tibiotarsal organ with the bristle simple but broader proximally, and 2 slipper-like appendages. Ventral tube very short, with short vesicles. Mucrones very large (*aquaticus* type) with inner lamella bearing 14 teeth in Imms' figure. Mucronal seta present. Abdomen dorsally with a few short curved scattered hairs. Length 0.5–0.75 mm.

Calcutta, India.

SMINTHURIDES BIFIDUS Mills

Plate V, figs. 42–48

1934, *Smynthurides penicillifer* var. *bifidus* Mills p. 90.

Female. Yellow and purple; body yellow with a wide median dorsal blackish-purple stripe and broad irregular lateral stripes including the bases of the legs. The median stripe may be short and posterior or it may be broken into spots; the lateral stripes may be reduced or diffuse. Head yellow dorsally, face purple above the mouth, median frontal spot present. Eyes pigmented almost separately, the eyespots often U- or V-shaped (figure 42). First antennal segment unpigmented, 2nd partly or entirely violet, 3rd and 4th violet. Legs basally yellow and purple; femur with a purple stripe and purple apically; tibiotarsi pale, purple apically. Furcula mostly unpigmented, dens weakly pigmented apically and basally. Eyes 8 on either side, 2 on each side much smaller than the others. Antennae slightly longer than the head (1.2:1), with segments about as 10:11:20:36. Apical antennal segment annulate, with a total of 7 or 8 subsegments (figure 46), and with narrow secondary rings between the primary subsegments (evident in specimens treated with KOH). Ungues without lateral teeth, but the 3rd pair serrate distally on the posterior margin. Inner tooth usually present. Anterior and middle ungues long and slender, posterior pair shorter and heavier (figures 44, 45). Anterior and middle unguiculi with a stout subapical filament, dilating distally, exceeding the unguis and normally appressed to it. Posterior unguicular filament long, commonly split into 2 branches, but often into 3. Seta of tibiotarsal organ stout, bifid, usually extending far beyond the apex of the tibiotarsus. Vesicles of ventral tube simple, without terminal papillae. Corpus of tenaculum with a pair of anterior setae and an apical seta situated between 2 long lobes, anterior and posterior respectively; the latter lobe somewhat variable in length, rarely absent (in one male examined) (figure 43). Dentes about 2.5 times the length of the mucrones. Mucro

elliptical in dorsal aspect, about half as broad as long. Outer dorsal lamella entire, inner with as many as 16 teeth; mucronal seta present (figure 48). Dorsum of body with simple curving setae of moderate length. Five pairs of bothriotricha as usual, the posterior pair short. Length 0.7 mm.

Male. Coloration similar to that of the female but often entirely yellow dorsally. Antennae to the head as 1.7:1, with the segments about as 13:15:9:18 or 32:38:20:44, the 2 middle segments modified for clasping; 4th segment simple. Mucro suborbiculate; outer dorsal lamella entire, supported by a heavy transverse tooth-like bar; inner lamella with as many as 11 teeth (figure 47). A subdorsal pair of hyaline globose extrusible vesicles is present on the metanotum. Length 0.45 mm.

In the type specimens the pigment was dense in the females, which were blue-black with a few roundish, lighter spots showing through; the appendages were also dark, the legs and furcula, however, lighter. The subsegmentation of the 4th antennal segment of the female is not especially apparent, and is nearly invisible in young specimens. A few specimens show evidence of a tunica on the unguis but this does not seem to be characteristic.

Hundreds of individuals were received from T. H. Hubbell which were collected in Florida. Many of these had unicellular algae and plant tissue in their alimentary tracts. This species is usually an inhabitant of water surfaces, but 1 specimen was taken from moss by Mr. C. Macnamara.

Florida, Louisiana, Iowa, Minnesota, Ontario.

SMINTHURIDES PENICILLIFER (Schäffer)

Plate VI, fig. 49

1896, *Sminthurus penicillifer* Schäffer p. 211. 1900, *Sminthurus (Sminthurides) penicillifer* Börner p. 617. 1901, *Sminthurides penicillifer* Börner p. 92.

var. PENICILLIFER f.p.

A more or less broad stripe on each side of the abdomen which usually extends over the 5th and 6th abdominal segments; this stripe extends over the sides of the thorax and bases of the legs as a paler or darker violet pigmentation. Posteriorly on the 4th abdominal segment are 2 black stripes which broaden posteriorly and which are sometimes united behind; scarcely reaching the thorax anteriorly. Oral region,

antennae, legs, manubrium, and dentes more or less gray-blue. This is the coloration of both sexes. Antennae much longer than the head, the 4th segment simple or ringed, not subsegmented, the segments about as $1:1\frac{1}{2}:4-5:6-7$. Male antennae with clasping organ, the segments as $1:1\frac{2}{5}:1:2$. Eyes 8 on either side of the head. First 2 pairs of claws differ from the 3rd. Anterior unguis without teeth or tunica tunica (Schäffer), Börner (1901) shows an inner tooth; anterior unguicular filaments slender, pointed, exceeding the apex of the unguis. Posterior unguis shorter and broader than the anterior ones, often beyond the middle a weak inner tooth; posterior unguiculi weakly curved, with well developed inner and outer lamellae; the posterior unguicular filaments are divided into 5 or 6 branches at about the middle, brushlike (figure 49). Tibiotarsal organ with 2 short papillae and a broad, bifid seta. Furcula relatively large, the dens 2.3 to 3 times the mucro. Mucrones convergent, between *aquaticus* and *malmgreni* in width; inner lamella with 8-12 teeth. The ventral lamella shows traces of ribs. Corpus of tenaculum overreaching the rami, with 2 long anterior setae and 1 smaller and terminal; rami 3-toothed, with the usual basal clavate appendages. Setae of body and appendages strong, especially posteriorly on the abdomen. Integument granulate. Length, female 1.0 mm., male 0.3 mm.

var. INCOMPTUS Börner, 1901, p. 94

Eyes on black eyepatches. All other dark pigment absent. This form intergrades with the typical form.

This European species has been taken from water covered with water plants in Germany, Switzerland, Finland, and Russia. It is probably widespread at least in central and Northern Europe.

SMINTHURIDES PAULIANI Denis

1936, *Sminthurides pauliani* Denis p. 127.

"The species is very near *S. penicillifer* (Schäf.), and a comparative diagnosis will suffice. . . . For Ant. IV, Börner says: 'simple or ringed, not subsegmented.' *S. pauliani* possesses ant. IV which I would willingly qualify as 'subsegmented.' Between the false segments are seen easily clear lines, indicating without doubt something more than a superficial annulation. . . . Although Börner does not give a figure of the antennae I am convinced that, if he had seen what I see he would have described it. One notices then this first difference from *penicillifer*:

ant. IV female, more clearly subsegmented in the case of *pauliani* than *penicillifer*, this irregular subsegmentation tending to cut the segment into large subsegments which are separated by one or several annular swellings. In comparing the tarsal III organ of *pauliani* with fig. 11 (Taf. II) (Börner, 1901) I find that the two branches of the bifid bristle are different. In *penicillifer* the dorsal branch does not attain the base of the unguiculus, it passes it considerably in *pauliani* where the unequalness of the two branches is much greater. . . . The aspect of the claws differs clearly from that which Börner reproduces for *penicillifer*; the axes of the two claws are parallel . . . but the principal difference, upon which I propose to base a new species, resides in the fact that the unguicular bristle of the first 2 pairs of feet, instead of being 'simple, sharp,' is here flat, clearly larger than the figure 11 of Börner, very clearly enlarged and lance-shaped in its distal part. These things are so clear that it is certain that any observer would not fail to see it."

Fontainebleau Forest, France, from the surface of water.

SMINTHURIDES SCHÖTTI Axelson

Plate VI, figs. 50-52

1902, *Smintthurides* sp. Schött p. 36. 1903, *Smintthurides schötti* Axelson p. 12.

Female. Oral region dark purple. Antennae violet. Legs pale with tibiotarsi violet. Dentes unpigmented. Body high-arched. Eyes 8 on either side. Antennae slightly longer than the head as 9:8, with segments about as 1:1.5:3.5:7. Fourth antennal segment with 4 subsegments, as 7:3:3:7; basal and apical subsegments thus equal in length (figure 52). Unguis with a small inner tooth and a pair of minute lateral teeth behind the middle. Filaments of the unguiculi exceeding the ungues. Seta of tibiotarsal organ simple, attaining the end of the tibiotarsus (figure 51). Ventral tube with several (6?) terminal papillae. Dentes from 2 to 2.2 times the length of the mucrones, each with an inner distal tooth. Mucrones apically swollen spoon-shaped, with relatively narrow lamellae (figure 50). Inner dorsal lamella with 10-15 teeth; ventral lamella ending before the apex; mucronal bristle present. Setae of dorsum sparse anteriorly, longer and more numerous posteriorly. Three pairs of bothriotricha on the body and 2 pairs on the anogenital segment. Integument minutely granulate. Length 0.4 mm.

Male. Antennae much longer than the head (as 12-8), modified for clasping. Length 0.20-0.25 mm.

Axelson (1903) designated 3 forms of this species, which associate together and intergrade with each other.

var. SCHÖTTI f.p.

Yellowish throughout, or pale violet or reddish. Antennae violet, the last 2 segments darker. Oral region dark violet or blue. Finland, Scandinavia.

var. BILINEATUS Axelson, 1903, p. 13

Posterior region of abdomen with a pair of narrow dark violet or blue stripes. Finland, Norway.

var. ORNATUS Axelson, 1903, p. 13

Dorsum with a broad dark median stripe. Median line pale, narrow, with lateral transverse branches. Abdomen with a spot on either side. Finland.

Specimens of this species which we have examined, received from Dr. M. Kseneman of Czechoslovakia, agree with the description of Linnaniemi (1912, p. 267). According to Linnaniemi this species is commonest in bogs in sphagnum moss, occurring less frequently on the surface of water. It occurs not only on fresh water but also on salt water in rock pools.

Finland, Norway, Germany, England, Czechoslovakia.

SMINTHURIDES PARVULUS (Krausbauer)

Plate VI, figs. 53, 54

1902, *Sminthurus parvulus* Krausbauer p. 27.

Bluish violet, sides of the abdomen with grayish white spots. Head yellowish brown; mouth dark violet. Eyespots black, bordered mostly with yellow. Frontal spot quadrate. First 2 antennal segments brownish yellow, 3rd and 4th violet. Sternum and legs pale violet. Furcula almost unpigmented. Antennae longer than the head, the 4th segment as long as the 3 preceding combined and with 5 subsegments; proximal and distal segments subequal, intermediate segments smaller and subequal. Unguis slender, without teeth. Unguiculus untoothed, slender on the first 2 pairs, broader on the last, with simple filaments which exceed the unguis. Dentes 2 times the mucrones. Mucro spoon-like, $\frac{1}{3}$ as broad as long. Outer (?) lamella toothed, toward the distal

end somewhat broadened, ending in a wide, blunt tooth (figure 53, 54). Mucronal edges widely open distally. Length 0.25–0.30 mm.

This species was described from specimens collected in Germany from the surfaces of pools in wooded areas.

SMINTHURIDES ASSIMILIS (Krausbauer)

Plate VI, figs. 55–61

1902, *Sminthurus assimilis* Krausbauer p. 28. 1901, *Sminthurides assimilis* Börner p. 138.

Female. Yellow and purple. Sides of body blackish purple, this pigment usually continued behind around the abdomen, and also across the head. Dorsum of body yellow with pairs of blackish purple spots as in figure 59–61. Head yellow above, face blackish purple above the mouth. First 2 antennal segments unpigmented or the 2nd violet apically; 3rd and 4th dark violet. Legs weakly pigmented; femora spotted with violet; tibiotarsi violet, darker apically; or legs violet throughout. Furcula unpigmented or slightly pigmented; manubrium spotted with violet, dentes also basally and apically. Eyes 8 on either side, 2 in each group smaller than the rest. Antennae longer than the head as 1.2:1, with segments about as 19:20:39:69. Apical antennal segment with 4 subsegments of the proportions 35:9:10:15 or 38:13:10:19 or 43:12:12:21; the basal subsegment twice as long as the apical (figure 55). Ungues with a pair of lateral teeth and with an inner tooth beyond the middle, which is weak or absent on the hind feet (figure 56, 57). Unguiculi much broader on the hind feet, each with a simple subapical filament exceeding the unguis. Seta of tibiotarsal organ exceeding the tibiotarsus, simple, lamellate; the basal papillae strong. Vesicles of ventral tube with 6 (?) blunt conical terminal papillae. Corpus of tenaculum with a pair of long curving anterior setae and a 3rd subapical bristle. Rami tridentate with basal clavate appendages. Mucro $\frac{2}{5}$ as long as the dens, spoonshaped, $\frac{1}{3}$ – $\frac{2}{5}$ as broad as long. Outer lamella entire or with a single tooth; inner with 10–13 teeth, terminating in a sharp, toothlike projection (figure 58). Mucronal seta present. Body setae of moderate length, sparse. Five pairs of bothriotricha present on the abdomen, 2 pairs of which are on the 5th segment, the posterior pair long. Integument minutely tuberculate. Length 0.5 mm.

Male. Yellow above, purple along the sides, with the usual clasping antennae. Length 0.44 mm.

This species occurs on water surfaces and also in humus.

Massachusetts, Louisiana, Texas, Ontario, Germany, Finland, Russia.

SMINTHURIDES KRAUSBAUERI nom. nov.

Plate VI, figs. 62-65

1902, *Sminthurus signata* Krausbauer p. 26 (nec *Smynthurus signata* (Fab.) Templeton).

The *Podura signata* of Fabricius (Ent. Syst. t. II, p. 65) was referred to the genus *Smynthurus* by Templeton (1835, p. 97) and there listed by him as *Smynthurus signata* Fabricius. Nicolet followed Templeton in this assignment (1841, p. 81). Under Art. 35 of the International Rules of Zoological Nomenclature, *Sminthurus signatus* Krausbauer (1898) becomes a primary homonym of *Smynthurus signata* (Fab.) Templeton, and the former name is not tenable.

var. KRAUSBAUERI f. p.

Yellowish brown, a distinct median dorsal pale yellow mark enclosing a still lighter cross-shaped mark. Two irregular subdorsal dark brown stripes. Clear lateral spots. Head yellowish, oral region dark. Eyespots black, bordered mesally with yellow. Quadrate frontal spot present. First 3 antennal segments yellowish brown; 4th violet. Sternum, legs, and furcula pale to colorless. Antennae longer than the head, 2nd segment longer than 1st; 3rd about equal to the basal 2; 4th equal to the rest of the antenna, with 4 subsegments, the proximal equalling the distal. Ungues slender, untoothed, without tunica. First 2 pairs of unguiculi slender with a long filament, 3rd pair with a long filament. Seta of tibiotarsal organ simple (no lamella), reaching almost to the end of the segment. Dens 2 times the mucro. Mucro spoon-shaped, $\frac{1}{3}$ as broad as long; outer (sic) lamella toothed, not reduced distally, somewhat turned up. Border not closed distally, with a shallow sinuate opening. Length 0.25-0.35 mm. Germany.

var. DISTINCTUS LINNANIEMI, 1912, p. 262

Dorsum of body blue or purple, sides of body with round pale spots. Segmentation evident dorsally, the segmental lines pale. Head mostly bluish. First antennal segment pale basally, blue apically; remainder

of antenna blue. Legs blue. Manubrium and dentes pale blue. Eyes 8 on either side. Antennae longer than the head (as 1.3:1); segments about as 3:5:10:15; 4th segment with 4 subsegments, the proximal twice as long as the distal; an additional intermediate subsegment may be indicated (figure 65). Ungues strongly curved; without inner teeth (figure 62), with a pair of minute lateral teeth (seen only on the fore feet of the single specimen examined). First 2 pairs of unguiculi slender, with subapical filaments which greatly exceed the unguis; 3rd unguiculi broadly lanceolate with a subapical filament. Tibiotarsal organ with a simple bristle which extends slightly beyond the tibiotarsus (figure 63). Corpus with 2 anterior setae; rami tridentate with basal clavate appendages. Dentes to mucrones as 11:5. Mucro with outer lamella entire; inner lamella about 10-toothed; mucronal seta present (figure 64). Bothriotricha as usual, 5 pairs, the posterior pair short. Integument weakly granulate. Length, female, 0.6 mm.

We have examined one female which we refer to this variety.

Kelly Lake, Ontario, May 11, 1931. H. G. James. Finland.

SMINTHURIDES INEQUALIS Börner

1903, *Sminthurides inequalis* Börner p. 160.

Dark blue; sternum somewhat paler. Eyes 8 on either side. Antennae longer than the head; segments 2:3:4: as $1:1\frac{2}{3}:3\frac{2}{7}$; 4th segment with 5 subsegments, of the proportions $2\frac{2}{5}:1:1\frac{1}{6}:1\frac{1}{6}:1\frac{2}{3}$. Anterior and posterior ungues not differing greatly in length, a little longer and more slender on the anterior 2 pairs. Inner and lateral teeth absent. First 2 pairs of unguiculi with subapical filaments, exceeding the unguis slightly, very small inner and broader outer lamellae with straight margins; 3rd unguiculi with small outer and broader inner lamellae, the filaments somewhat exceeding the ungues. Seta of tibiotarsal organ slender and simple. Furcula slender. Dens $2\frac{1}{3}$ times the mucro; mucro with a broad inner, very small ventral, and $\frac{3}{4}$ length outer lamella. Inner lamella with 7 teeth. End of mucro bent upward as in *S. violaceus*, free, without lamellae. Vesicles of ventral tube very short. Corpus of tenaculum with 2 pairs of setae; rami tridentate. Body hairs not thick but relatively long and fine. Length 0.75 mm.

This species was described from 1 specimen collected from beneath a flower pot in the Botanical Gardens, Palermo, Italy.

SMINTHURIDES ANNULICORNIS Axelson

Plate VIII, figs. 66-70

1905, *Sminthurides annulicornis* Axelson p. 793.

Dark blue, including head, antennae, legs and furcula. Unpigmented spots and streaks on the sides of the body. Sternum somewhat paler. Eyes 8 (?) on either side. Antennae very slender and long, 1.5 times the length of the head; 4th segment with 7 moniliform subsegments (figure 70). First and 2nd pairs of unguis (figure 67) with a very small inner tooth and minute lateral teeth; 1st and 2nd pairs of unguiculi narrow, with weak lamellae, the filament exceeding the unguis. Third unguis much broader, with very minute inner and lateral teeth (figure 66); unguiculi very broad, with rounded lamellae. Filament long, exceeding the claw. Seta of tibiotarsal organ exceeding apex of that segment, lamellate basally and obscurely bifid. Sacs of ventral tube with apical papillae (figure 68). Dens 3 times the mucro. Mucrones somewhat convergent, about as wide as *penicillifer*, narrower than in *aquaticus*; inner lamella with about 12 teeth, lateral and ventral lamellae ribbed (figure 69). Clothing fine and sparse. Three pairs of bothriotricha on the body and 1 pair on the anogenital segment. Integument granulate. Length 0.6 mm.

In many respects this species is close to *aquaticus*.

One specimen, taken at Pottageville, Ontario, is assigned to this species. In this specimen, however, the apex of the ventral tube is furnished with a half-dozen papillae. Linnaniemi (1912, p. 261) states that they are apparently absent in *annulicornis*. The basal subsegment of the 4th antennal segment is weakly separated into 2 divisions. The subsegmentation in general is strongly developed in the specimen at hand, the reagents having pulled the inner tissue away from the chitinous covering, or perhaps the specimen was ready to moult.

Finland, Ontario.

SMINTHURIDES MACNAMARAI spec. nov.

Plate VII, figs. 71-76

Female. Body and head mostly purple; head paler. Body laterally purple or olivaceous with many pale spots. Antennae violet. Legs dilute purple. Furcula unpigmented, sometimes, though, pigmented even to the mucrones. As a variation the dorsum may be ferruginous, the body with more or less blue; first 2 antennal segments ferruginous, 3rd and 4th violet; legs and furcula tinged with violet, the tibiotarsi

pale brownish. Eyes 8 on either side, the 2 inner eyes of each group much smaller than the others. Antennae long and slender, 1.2 to 1.4 times the length of the head, with segments about as 10:13:26:45. Fourth segment normally with 4 subsegments, about as 28:8:6:13 (figure 73). The basal segment is from 2.2 to 2.4 times the length of the apical. Fifth abdominal segment evident as a rounded ridge which is demarkated anteriorly and posteriorly by a suture. Ungues with an inner tooth before the middle and a pair of lateral teeth (figures 71, 72), inner tooth of hind unguis very small. First 2 pairs of unguiculi sublanceolate, 3rd subovate; the subapical filaments simple, exceeding the ungues. Setae of tibiotarsal organ bifid, attaining or slightly exceeding the segment. Vesicles of ventral tube with papillae. Dentes from 2.2 to 2.4 times the length of the mucrones, with an inner subapical tooth and a rather heavy subapical dorsal bristle. Mucrones with the midrib projecting as a strong tooth; with lamellae apically truncate and rounded; outer lamella entire, inner lamella with as many as 13 teeth; mucronal bristle present (figures 74-76). Clothing of dorsum anteriorly sparse, posteriorly moderately long and slender, especially just before the anogenital segment. Three pairs of bothriotricha on the body and 2 pairs on the 5th segment. Maximum length 0.52 mm.

Male. In coloration and structure similar to the female. Antennae with the usual clasping organ, the 4th segment simple. Metanotum with a dorsal pair of vesicles, rather close together. Length 0.22 mm.

In young females the 4th antennal segment is not subsegmented. In old females the 4th segment occasionally has a 5th subsegment delineated. In one female the posterior edge of one hind unguis was irregularly serrate.

Iowa: Leon, October 10, B. V. Travis.

Louisiana: Tallulah, April 20, in damp humus under dead leaves, J. W. F.

Canada: Arnprior, Ontario, June, August, September, in damp moss, C. Macnamara. These specimens were in the company of *S. occultus* and *S. assimilis*.

SMINTHURIDES OCCULTUS Mills

Plate VII, figs. 77-81

1934, *Sminthurides occultus* Mills p. 91.

Female. Yellow, marked with purple (figure 81). On each side of the body is a wide purple stripe with irregular margins. Dorsum

yellow with a pair of longer or shorter subdorsal stripes that usually join the lateral stripes posteriorly, and sometimes anteriorly. Head mostly yellow, oral regions purple. Antennae largely purple, the 1st segment pale. Legs yellowish, tibiotarsi pale purple distally. Sternum and furcula unpigmented. Eyes 8 on either side. Antennae longer than the head, as 1.3:1. Segments about as 5:10:21:43, or 8:11:22:45; 4th segment with 4 subsegments, in relative lengths about as 20:7:6:10, the basal segment thus 2 times as long as the apical (figure 79). Ungues with a tunica, stout, 2 pairs of lateral teeth and a small inner tooth beyond the middle (figure 80). Unguiculi with simple subapical filaments which exceed the unguis and which are weakly knobbed. Seta of tibiotarsal organ sometimes slender and extending almost to the end of the tibiotarsus, but usually shorter and stout, occasionally conical and lamellate or weakly bifid. Vesicles of ventral tube ending in blunt conical papillae (figure 77). Corpus of tenaculum with a pair of long anterior setae; rami tridentate with the usual basal clavate appendages. Dentes 2.5 times the mucrones, which are bulbousapically and with a mucronal seta (figure 78). Outer dorsal lamella entire, with 6-8 teeth. Ventral lamella entire. Dorsum with rather long stiff setae, longer and more abundant posteriorly. Five pairs of bothriotricha, 2 of which are on the 5th abdominal segment. Length 0.4 mm.

Male. Antennae longer than the head, as 1.5:1, the segments as 12:21:14:25; modified for clasping. A pair of subdorsal hyaline metathoracic vesicles. Length 0.27 mm.

This species is one of the most common members of the genus inhabiting moss and leaf mould in North America.

North Carolina, Iowa, Ontario, Manitoba (Churchill).

SMINTHURIDES LEPUS Mills

Plate VIII, figs. 82-87

1934, *Sminthurides lepus* Mills p. 91.

Female. Dark blue or blackish purple and white. Characteristic is a large dorsolateral white spot on either side of the abdomen; the 2 spots commonly but not always confluent dorsally (figure 84). Abdomen mostly pigmented laterally and posteriorly. Anterior region of dorsum mostly white. Fifth abdominal segment often blue anteriorly or entirely, 6th segment, also the sternum posteriorly, white. Head white with oral region dark. The white areas are sometimes tinged with yellow, especially anteriorly. Antennae purple, darker distally, the

1st segment paler and sometimes brownish. Legs unpigmented beyond the coxae or trochanters, or the tibiotarsi dilute purple distally. Eyes 8 on either side. Antennae longer than the head, as 1.3-1.6:1, the segments about as 20:23:52:90, 4th typically with 5 evident subsegments, in relative lengths about as 31:11:12:10:17; occasionally there are 6 subsegments or the basal segment is 2-lobed and obscurely represents 2 subsegments (figure 87). Small annulations are represented at the articulations of the definite subsegments. All unguis have a tunica, an inner tooth, and a pair of lateral teeth (figure 86). Filaments of the unguiculi reduce in length posteriorly: exceeding the unguis on the 1st pair, subequal or slightly exceeding the unguis on the 2nd, and subequal on the 3rd; they are weakly knobbed. The seta of the tibiotarsal organ is simple or weakly bifid, short, not attaining the apex of the tibiotarsus (figure 85). Corpus of tenaculum short, with 3 anterior setae, close together, the single one nearer the apex; rami tridentate with the usual clavate basal appendages (figure 82); the tenaculum in some respects resembles the condition in *Denisiella*. Dens 2.5 times the length of the mucro; mucro with an apical bulb; outer dorsal lamella entire; inner dorsal lamella with 7-11 teeth; ventral lamella ending in a subapical tooth (figure 83). Mucronal seta present. Five pairs of bothriotricha present, 3 on the 4th abdominal segment, and 2 on the anogenital segment. Dorsum of body with moderately long stiff setae, sparse anteriorly. Integument pseudotuberculate, appearing granulate but the surface smooth. Length 0.53 mm.

Male. Similar in color and structure to the female, but with the usual modification of the antennae for clasping. A pair of metanotal hyaline eversible sacs present. Length 0.27 mm.

In small individuals, about 0.3 mm., the 4th antennal segment shows no trace of subsegmentation.

This species is a rather common inhabitant of moss and leaf mould, and is rather widespread in North America.

Iowa, Illinois, Louisiana, North Carolina, Ontario.

SMINTHURIDES PLICATUS (Schött)

Plate VIII, fig. 88

1891, *Smynthurus plicatus* Schött p. 13.

The ground color is white with a light reddish tinge. The head is light but for the especially large black eyespots and a black spot in the region of the mouth. The thorax is entirely light, the abdomen fur-

nished with 2 lateral and 1 median dark stripes. These bands extend along the whole length of the abdomen and are so broad that the light color appears only as 2 oval spots on the sides of the animal, as a result of which it is very difficult to decide whether the light or the dark color is the ground color. The legs and the furcula are weak violet, the antennae dark blue-violet. The apical segment of the antenna is clearly annulate, and has only five distinct sub-segments; the 3 intermediate divisions are small and of equal size, the 1st and last on the contrary longer and subequal to each other. On these it is possible to see further tendency toward subsegmentation. Tenent hairs absent. The mucro is as peculiar as it is beautiful (figure 88). It is trough-shaped, the outer edges thin and folded. It ends in a ring. Whether this is a light aberration or a frame for a chitin membrane is not evident.

This California species was described from 2 specimens, and has not since been recorded. Doubtless, when it is again studied the description will be emended.

California.

Subgenus STENACIDIA Börner, 1906, p. 182

Antennae of female a little shorter than the head, the 4th segment simple. Ungues tunicate (weakly in *violaceus*). Mucro with upturned apex and very weakly lamellate, the inner lamella toothed. Mucronal bristle present or absent. Integument finely granulate. Tibiotarsal organ present. Type *S. (Stenacidia) violaceus* (Reuter).

Key to the species of the subgenus *Stenacidia*

Dorsum with about 15 very long strongly curving feathered hairs.

hystrix Börner 1903. P. 263

Dorsum without long curving feathered hairs.*violaceus* Reuter 1878 P. 262

SMINTHURIDES (STENACIDIA) VIOLACEUS (Reuter)

Plate VIII, fig. 89

1878, *Sminthurus violaceus* Reuter p. 203. 1900, *S. (Sminthurides) violaceus* Börner p. 616. 1901, *Sminthurides violaceus* Börner p. 98. 1906, *Sminthurides (Stenacidia) violaceus* Börner p. 182.

Violet, paler or darker, sometimes the back clear and practically unpigmented. Sides of the body with clear streaks and spots. Sternum paler. Head violet, oral region always dark; a black spot between the

antennae. Legs and antennae violet. Antennae a little shorter than the head, the 4th segment simple. Unguis with an inner tooth and a very delicate tunica, inner tooth apparently absent from hind feet. First 2 pairs of unguiculi narrow, the 3rd broad and shorter; filaments exceed the unguis and are clearly knobbed. Tibiotarsal organ with the seta simple, not lamellate, short, somewhat broadened basally. Ventral tube without appendages. Mucro slender, the inner edge toothed (figure S9); no true lamellae occur; distally suddenly narrowed. Mucronal bristle present. Dentes strongly divergent, at the most 2.5 times the mucrones. Corpus of tenaculum with 2 pairs of long setae; rami tridentate, with basal appendages. Bothriotricha (Linnaniemi, 1912, p. 251) present as 3 pairs on the body and 1 pair on the anogenital segment. Male with the usual clasping organ. Length 1 mm.

This species inhabits the surface of pools, decaying wood, grass, etc. It has not up to the present been recorded from North America.

Germany, Finland, Scandinavia, Poland, England, Australia.

SMINTHURIDES (STENACIDIA) HYSTRIX Börner

1903, *Sminthurides hystrix* Börner pp. 161-163.

Dark violet, broken here and there by clearer spots. Sternum pale. Several clear spots on coxae. Juveniles paler and in alcohol somewhat reddish. Ends of the legs and antennae always dark violet. Eyes 8 on either side. Antennae short, $\frac{7}{8}$ as long as the head, the segments as $1:1\frac{1}{5}:1\frac{1}{5}:2-2\frac{1}{7}$; 4th segment simple. Ungues all of about equal length, with a strong inner tooth near the middle and a pair of lateral teeth $\frac{2}{3}$ from the apex. Tunica evident. First 2 pairs of unguiculi little different from the 3rd. Filament subapical, thickened. Seta of tibiotarsal organ broadest at the middle, distally strongly narrowed, pointed, simple. Basal teeth or swellings strong. Tenaculum plump, anterior lobe with 1 strong seta, posterior part hidden between the rami which are 3-toothed and bear a basal clavate appendate. Furcula slender; dens to mucro as $2\frac{1}{4}:1$. Inner dorsal lamella with about 22 fine teeth. Outer margin *without* lamella. End of mucro a little bent. Mucronal seta absent. Integument finely granulate. Thorax and abdomen with about 15 very long, strong curving feathered setae which are rather rough at the apex. Three pairs of bothriotricha are present on the 4th abdominal segment and 1 pair on the 5th. Length up to 0.8 mm.

The heavy, fringed hairs are characteristic of this species. In many respects it resembles *violaceus* (Reuter).

Collected from beneath flower pots in the Botanical Gardens of Palermo, Italy. Possibly not a native of that country.

Subgenus DENISIELLA subgenus nov.

Apical antennal segment simple. Tibiotarsal organ of 3rd pair of legs absent. Corpus of tenaculum considerably shorter than the rami, with anterior but not apical bristles. Mucronal lamellae very weak, the outer lamella ending short of the apex. Mucronal bristle present. Postero-internal face of the hind bitiotarsi with several (unusually 5) heavy, crenulate bristles; similar bristles on the apex of the 1st and sometimes the 2nd tibiotarsi and near the anus. Claws of all feet similar. Bases of bothriotricha of body forming a triangle. Males with clasping antennae and 4 swellings at the base of the anterior tibiotarsi. Anogenital segment strongly constricted. Type: the excellently described *Sminthurides securati* Denis.

Key to the species of the subgenus Denisiella nobis

1. No crenulate or serrate bristles near the anus.
serrosetosa Börner 1908. P. 264
 Crenulate bristles situated near the anus. 2
2. Two crenulate bristles near the anus. *securati* Denis 1925. P. 265
 Six crenulate bristles near the anus. 3
3. Longest dorsal bristles longer than the mucro. Second antennal segment
 longer than the 3rd. *ramosus* Folsom 1932. P. 266
 Longest dorsal bristles $\frac{2}{3}$ the length of the mucro. Second antennal seg-
 ment shorter than the 3rd. *sexpinnatus* Denis 1931. P. 267

SMINTHURIDES (DENISIELLA) SERROSETOSA Börner

Plate VIII, figs. 90, 91

1908, *Sminthurides (Stenacidia) serrosetosa* Börner p. 58.

Female. Dark violet throughout; tibiae and furcula paler. Antennae very short, a little more than half the length of the head, the segments as $1:1\frac{4}{5}:1\frac{2}{5}$ or $1\frac{2}{9}:1\frac{1}{9}:1:2$. Second segment swollen basally (figure 90). Ungues alike on all of the feet, with 1 inner tooth and a row of sub-basal external denticles (figure 91). Unguiculi small, only slightly widened basally, bearing short filaments which do not reach the apex of the ungues. Tibiotarsal organ absent, but posterior tibiotarsus with serrate bristles which have many teeth. Dens 2 to 2.5 times the length of the mucro. Inner border of the mucro finely toothed

outer narrow, ending just before the apex; constricted at the distal third. Mucronal seta present. Corpus of tenaculum short, broad, with 2 anterior setae. Clothing sparse and rather short. Setae of legs and antennae with roughened surfaces. Length 1.1 mm.

Male. With the usual clasping antennae, the segments about as 5:7:4:5.5. Crenulate bristles of hind tibiotarsus two-toothed. Inner tooth absent from the unguis. Unguicular filaments knobbed on the 1st 2 pairs of legs. Antennae slightly longer than the head, as 43:40. Metanotum with a pair of dorsal vesicles. Length 0.45 mm.

South Africa.

SMINTHURIDES (DENISIELLA) SEURATI Denis

Plate VIII, figs. 92, 93

1925. *Sminthurides seurati* Denis p. 273.

Female. Cream white, often with violet on the back and frons. The violet may extend and cover the entire back; it may also be quite intense. Legs and furcula always violet. Sternum light. Eyes 6 on either side of the head, 2 frontal ocelli present. Antennae a little shorter than the head, the segments as 12:15:17:29, the 4th segment not subsegmented. First tibiotarsus with a strong toothed bristle on the anter-inner extremity; 3rd tibiotarsus with 5 strong toothed setae on the postero-inner face, the most proximal the smallest. Unguis alike on all feet (figure 92), an inner tooth present but often difficult to see. Lateral teeth absent, but a sub-basal transverse outer row of denticles is present. Unguiculi alike on all feet; straight, the filament exceeding the unguis. Corpus of tenaculum short, broad, with 2 anterior setae. Rami tridentate, with basal clavate structures (figure 93). Dens about 2.6 times the mucro. Mucro somewhat *Stenacidia*-like, with definite lamellae. Outer lamella entire, extending almost to the apex; inner lamella serrate. Mucronal bristle present. Two short serrate bristles near the anus. Length 0.8 mm.

Male. Pale or weakly violaceous. Antennae about 1.5 times the length of the head, the segments about as 5:4.5:2:4, modified for clasping. First tibiae curiously modified: dilated proximally, and externally with 4 linear swollen organs. Inner tooth difficult to see on the hind feet. Inner teeth of the mucro less in number than in the female. Olfactory hairs of the 4th antennal segment more highly developed than in the female, 2 externo-ventral and 1 externo-dorsal. Length 0.6 mm.

Taken from the surface of water, Mangareva Island, Rikitia.

SMINTHURIDES (DENISIELLA) RAMOSUS Folsom

Plate VIII, Figs. 94-101

1932, *Sminthurides ramosus* Folsom p. 72.

Female. Head and body mostly purple. Sternum unpigmented. Antennae dull to clear purple throughout. Legs pale, tinged with purple. Manubrium slightly pigmented; dentes unpigmented. Eyes at least 12, possibly 16, on black spots. Antennae subequal to the head in length, elbowed between the 1st and 2nd segment, with segments about as 10:16:15:27. Organ of 3rd antennal segment with a pair of oval or subreniform lobes. Fourth antennal segment simple; olfactory setae not evident. Thoracic segmentation not evident dorsally. Genital and anal segments ankylosed into a single, well-constricted mass. Fore tibia with 1 stout disto-ventral weakly serrate seta (figure 95); middle tibia with a stout scarcely crenulate bristle in the same position (figure 96); hind tibia with 5 crenulate setae (figure 94). Unguis slender, with an inner tooth a little beyond the middle, 2 pairs of lateral teeth, and 1 minute basal tooth externally; similar on all feet (figures 97, 98). Unguiculus half as long as the inner margin of the unguis, slender, tapering, with a subapical filament longer than the unguiculus and exceeding the unguis; knobbed or not. Tibiotarsal organ absent. Vesicles of ventral tube smooth-walled. Dentes with strong simple curving setae dorsally, a dorso-median row expanded basally and half the length of the mucro; 3 dorsal bristles longer and more erect than the rest; ventrally with many short stiff appressed setae except basally. Mucro with the outer margin notched or entire; inner margin serrate and with a basolateral mucronal seta (figures 100, 101). Rami of tenaculum tridentate, with basal clavate appendages; corpus short, with 2 (rarely 3) anterior setae (figure 99). Head and body with strong stiff spinelike setae, some of which are weakly rugose; the longest dorsal bristles are longer than the mucro and the longest anogenital bristles are more than half its length. The anus surrounded by crenulate hairs. In the manner of branching these setae vary considerably. Five pairs of bothriotricha are present; 3 pairs on the dorsum, their bases forming a flat equilateral triangle; 2 pairs on the anogenital segment. Integument weakly granulate. Length 1.0 mm.

Male. Body and antennae purple. Legs tinged with purple. Furcula unpigmented. Antennae remarkably stout, a third longer than the head, with segments as 10:9:4:8. Middle antennal segments form-

ing a clasping organ. Apical antennal segment simple, elliptical. Each tibiotarsus of the front legs bears basally on the outer side 4 sense organs, suboblong, thick-walled, and slightly elevated. Claws and mucrones similar to those of the female, although the mucrones are more slender. Length 0.6 mm.

Further study of the types of this species result in the emendation of the original description. The closest relative of this species is *S. (Denisiella) sexpinnatus* of Costa Rica. The following differences may be noted:

<i>ramosus</i>	<i>sexpinnatus</i>
Ant. II (♀) greater than III	Ant. II (♀) less than III
2 pairs of lateral teeth on unguis.	4-5 pairs of lateral teeth on unguis.
A single externo-basal tooth on unguis.	A row of externo-basal teeth on unguis.
Clothing much longer and heavier, longest dorsal bristles longer than the mucro, the longest on the anogenital segment more than half the length of the mucro, longest dental bristle with swollen base half the mucro.	Clothing shorter, longest dorsal bristle 2/3 the mucro, the longest on the anogenital segment less than half the mucro.

Hawaii.

SMINTHURIDES (DENISIELLA) SEXPINNATUS Denis

Plate IX, fig. 102

1931, *Sminthurides sexpinnatus* Denis p. 156.

Color largely violaceous. Eyes 8 on either side, 2 in each eyepatch poorly developed. Antennae as long as the head, the segments as 7:9:11:18. Fourth antennal segment not subsegmented. Organ of 3rd antennal segment normal. Crenulate setae of tibiotarsi as in *ramosus* or *seurati*; 1 antero-internal subapical bristle on the 1st pair, 1 similarly placed but weakly crenulate on the 2nd pair, and 5 ranging along the postero-inner face of the 3rd pair. Ungues with 1 inner tooth, 4-5 lateral teeth, and an externobasal series of denticles (figure 102). Unguiculi slender, the filament exceeding the unguis. Tenaculum with the corpus short and rather flat, bearing a pair of anterior bristles; rami tridentate, with basal clavate appendages. Dens 2.6 times the mucro; outer lamella entire or with 1 or 2 obscure teeth, not attaining the apex. Inner lamella with many teeth. Mucronal seta present. Six crenulate seta surrounding the anus. Clothing abundant, the dorsal

abdominal bristles $\frac{2}{3}$ the mucronal length; those of the anogenital segment less than half the mucro. Length 1 mm.

This species is closest to *ramosus*. There are differences, as noted under the discussion of that species. However, *scrpinnatus* is known from but 1 female, and the range in variation of structures is unknown.

Costa Rica.

Subgenus SPHAERIDIA Linnaniemi 1912

Tibiotarsal organs of 3rd pair of legs absent. Mucrones without lamellae, the inner edge toothed; without mucronal bristles, slender, toward the apex not strongly narrowed. Fourth antennal segment simple, not subsegmented. Claspings organs of male antennae simple, the large opposing bristles small, nearly straight, without or with very poorly developed papillae and accessory structures. Bases of bothriotricha nearly in a straight line. Rami of tenaculum reaching beyond apex of corpus, 3-toothed, with a basal club; corpus heavy, normally with 2 anterior bristles and none apically. Anogenital segment broadly attached to body. Size small, rarely reaching 0.5 mm. in the female and 0.3 in the male. Type: *S. Sphaeridia pumilis* (Krausbauer).

Key to the species of Sphaeridia Linnaniemi

1. Antennae shorter than the head, about as 0.88:1
minimus (Schött) 1893. P. 271
 Antennae longer than the head or subsqual to it, about as 13:10, rarely as
 1:1 2
2. Hind tibiotarsae with 2 heavy appressed unilaterally serrate bristles on the
 antero-mesal face *serratus* n. sp. P. 268
 Hind tibiae without these serrate bristles
pumilis (Krausbauer) 1898. P. 270

SMINTHURIDES (SPHAERIDIA) SERRATUS spec. nov.

Plate IX, figs. 103-107

Brown or reddish brown, lighter along the sutures, with lighter roundish spots on the sides; prothorax light. Antennae brownish purple apically, paler basally. Legs weak bluish brown, furcula dilute brown. Venter lighter. Six eyes visible on either side, possibly 8 present as in other species of the genus. Third antennal segment organ normal. Antennae slightly longer than the head, about as 12:11; the

segments about as 5:8:9:26; 4th segment simple, with several subapical olfactory hairs (figures 103, 104). Ungues and unguiculi similar to *S. pumilis*, the inner tooth of the hind unguis often minute or apparently wanting. Ventral tube with simple vesicles. Corpus of tenaculum shorter than the rami, with 2 anterior bristles; rami tridentate, with basal clavate structures. Dentes less than 2 times the mucrones, about as 13:8, or 34:19; mucrones slender, without lamellae, the inner margin serrate, the outer with a notch at about the middle (figure 106). Mucronal bristle absent. Dorsal segmentation of the body usually visible. Dorsum with slender pointed slightly curving hairs in single rows across the anterior part of the dorsum, and a patch of more numerous long heavy pointed bristles on the posterior dorsum, the longest more than half the length of the mucro, as 19:33; anogenital segment with fewer more slender hairs. Three pairs of bothriotricha on the body, apparently 2 on the 2nd abdominal segment and 1 on the 3rd, their bases nearly in a straight line; anogenital segment with 2 pairs, the anterior longer and situated farther toward the sides than the posterior pair. Each hind tibiotarsus bears on its anterior inner face and near the middle 2 heavy nearly appressed unilaterally serrate bristles (figures 105, 107). Length 0.32 mm.

Males have not thus far been seen.

This species resembles closely *S. pumilis* (Krausbauer), from which it differs in the following respects:

<i>serratus</i>	<i>pumilis</i>
Serrate bristles on the hind tibiotarsus.	Such serrate bristles absent.
Subapical hairs on 4th antennal segment short, blunt, and heavy.	Subapical bristles of 4th antennal segment longer and more slender.
Dorsal segmentation usually evident.	Dorsal segments usually obliterated.
Heavy bristles limited to a postero-dorsal area.	Heavy bristles extend toward the front with no definite limitation at the middle of the dorsum.

S. (Sphaeridia) serratus is an inhabitant of leaf mould.

Louisiana, Tallulah, October 12, 1934, J. W. F.

Georgia, Jasper County, September 1, 1936, W. F. Turner.

North Carolina, Asheville, A. P. Jacot.

Missouri, Scott County, September 24, 1936, W. F. Turner, Wm. Anderson, James Graff.

SMINTHURIDES (SPHAERIDIA) PUMILIS (Krausbauer)

Plate IX, figs. 108-112

1902, *Sminthurus pumilis* Krausbauer p. 21. 1901, *Sminthurides pumilis* Börner p. 138. 1902, *Sminthurides globosus* Axelson p. 109. 1905, *Sminthurides pumilio* Axelson p. 40. 1912, *Sminthurides (Sphaeridia) pumilio* Linnaniemi pp. 248-249.

Body high arched. General color typically lighter or darker violet or purple, sometimes reddish or brown, with many pale spots of various forms and sizes. The general color varies from olivaceous to ferruginous. An anterior or posterior dorsal stripe may occur, and often there are wide median dorsal pale areas. Sternum, antennae, legs, and furcula paler violet; 4th antennal segment dark violet.

Female. Eyes 8 on either side, 6 usually plainly visible. Antennae a little longer than the head, rarely subequal to it; measurements of 4 specimens give proportions of 13:10, 87:83, 80:80, 151:134; with segments about as 1:3:2.5:6.5. Fourth antennal segment simple, not subsegmented. Ungues with a pair of small lateral teeth, those of the first 2 pairs of legs rather straight and slender, with a small distal inner tooth on each (figure 108). Ungues of 3rd pair of legs broader (figure 109), curving, with or without an inner tooth on each. Unguiculi of first 2 pairs of legs with a subapical filament which exceeds the unguis. Hind unguiculi broader, lanceolate, with or without a small filament. Tibiotarsal organ of hind legs absent. Tenaculum with tridentate rami, lateral appendages, and a pair of anterior setae (figure 111). Corpus exceeded by the apices of the rami. Dens from $1\frac{3}{4}$ to twice the length of the mucro. Mucro long and narrow, without lamellae; inner dorsal margin serrate; outer entire, with or without a tooth before the middle; ventrally obtusely excavated beyond the middle, in lateral aspect (figure 110). Mucronal seta absent. Body setae comparatively long and stiff; sparse anteriorly. Bothriotricha: 3 pairs on the large abdominal segment, 1 pair on the 5th and 1 pair on the 6th; those on the 6th segment are short and subdorsal. Length 0.55 mm.

In one specimen both posterior pairs of bothriotricha were apparently on the 5th segment, the 1st anterolateral and long and the 2nd subdorsal and short.

Male. The male is like the female structurally. Antennal segments as 15:34:21:72. Clasping organ relatively simple (figure 112). In one specimen 4 pairs of bothriotricha were noted on the body. Length 0.23 mm.

Variation. In the material examined, olivaceous and some ferrugin-

ous individuals have purple antennae and legs; other ferruginous specimens have ferruginous antennae (excepting the 4th segment which is always dark purple), legs and furcula. The furcula may be pigmented or not and the legs vary in their pigmentation, which may be lighter or darker, or sometimes spotted.

Denis (1933, p. 273) says that it is practically impossible to recognize the sex of young forms. They are pale, with only 6 of the 8 eyes pigmented, and without bothriotricha on the body (though they are present on the anogenital segment). In addition the first 4 abdominal segments are strongly reduced as in *Megalothorax*.

North America: Iowa, Louisiana, Utah, Manitoba (Churchill).

Costa Rica, Norway, Germany, Finland, Switzerland, Hungary, Poland, Czechoslovakia, Australia.

SMINTHURIDES (SPHAERIDIA) MINIMUS (Schött)

1893, *Sminthurus minimus* Schött p. 7. 1927, *S. Sph. m.* Schött p. 33.

Clear blue, stripes and points showing through the ground color. One male possessed a rectangular whitish stripe on the anterior dorsum. Head to the antennae as 1:0.88, the 4 segments as 1:1.66:1.5:4.17. Fourth antennal segment simple. Organ of 3rd antennal segment composed of 2 rods sunk in a cuticular groove. Ungues with an inner tooth near the middle, the first 2 pairs longer and more slender than the 3rd. First 2 pairs of unguiculi scarcely lamellate, slender; filament attaining the apex of the unguis. Unguiculi of hind legs comparatively broad, lanceolate; without or perhaps with a very weak subapical filament. Sense organs of 3rd tibiotarsi absent. Dentes swollen, bladderlike above, sparsely hairy. Mucrones gradually narrowing distally, ventrally weakly constricted at about the middle, with the inner margin serrate. Short sparse hairs on the head and anterior third of the dorsum, behind this fine needle-like hairs are present on the back. Two pairs of bothriotricha on the 4th abdominal segment (one specimen possessed 4 pairs), 1 pair on the anogenital segment. Fifth and 6th segments confluent. Length of male 0.5 mm, of female 0.3 mm.

Cameroons, West Africa; Kiev, Russia (?).

Schött (1927, p. 34) states that this species may be identical with *pumilis*. Comparative studies will be necessary to establish this fact.

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